

MACROFOSSIL EXTINCTION PATTERNS AT BAY OF BISCAY  
CRETACEOUS-TERTIARY BOUNDARY SECTIONS; Peter D. Ward and Kenneth  
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A causal understanding of the mass extinction occurring at the end of the Cretaceous Period requires accurate information about the biostratigraphic ranges of the affected and unaffected organisms involved. Such information, which can only come from detailed biostratigraphic examination of many Cretaceous-Tertiary boundary sections, can lead to conclusions about timing, duration, and synchrony of the extinction among affected taxa. Unfortunately, there are few known boundary sections where both larger marine macrofossils as well as microfossils can be recovered together. Although microfossil records are known from many boundary sections recovered by deep sea drilling, and from pelagic sedimentary facies exposed as land-based sections, there are relatively few known Cretaceous-Tertiary boundary sections exposed as shallow marine or shelf facies. We thus are left with little information about the timing of extinction among microfossils and larger marine macrofossils of the marine shelf regions.

Some of the most favorable sections for studying the Cretaceous-Tertiary transition in shallow water facies crop out along the coast of the Bay of Biscay. Stratigraphic sections exposed near Zumaya, and Sopelana, Spain, and Hendaye, and Bidart (Biarritz), France turn out to be excellent reference sections both for documenting Late Cretaceous macrofossil stratigraphy as well as yielding valuable information about the patterns of extinction immediately prior to the K-T boundary. All are exposed along seacliffs, and all contain a conformable sequence of Upper Cretaceous and Lower Tertiary marine strata. These strata were deposited in the Flysch Trough of the Basque-Cantabric Basin(1). This basin was one of several forming along the boundary of the European-Iberian Plates during the Late Cretaceous. During Campanian and early Maastrichtian time, sediments deposited in this basin were mainly of turbidity current origin. During the late Maastrichtian there was a change in depositional patterns, caused by a reduction in siliciclastic material influx, as well as basin-wide shallowing and regression. The result is that Lower Maastrichtian flysch is overlain by Upper Maastrichtian limestone-marl rhythmities. Sedimentation rates dropped, with Lower Maastrichtian accumulation rates at the thickest section, that exposed at Zumaya, Spain, estimated at 200 bubnoffs (m/m.y., compacted) compared to 60 to 80 bubnoffs (m/m.y., compacted) for the Upper Maastrichtian. Immediately following the K-T transition there was an even more dramatic reduction in siliciclastic influx into the basin, resulting in the deposition of pink coccolith limestones during the Danian (2).

Both microfossils and macrofossils can be collected in the Bay of Biscay sections. The ranges of Maastrichtian macrofossils have only been documented for the Zumaya section (3,4). New macrofossil collections made during 1987 now permit documentation of ranges in the other Bay of Biscay sections as well. Although an inoceramid-like bivalve (*Tenuipteria*) is found in the uppermost part of all of the sections, true inoceramids (*Inoceramus*, *Endocostea*, *Platyceramus*) range only into the basal beds of the *A. mayaroensis* Zone. Inoceramids are

common in the upper part of the Lower Maastrichtian at each section: they virtually form pavements along bedding planes. Specimens up to a meter in length are common. At least four species are common in the Lower Maastrichtian parts of the sections; all then disappear over a stratigraphic distance of approximately 40m. The disappearance of inoceramids well before the K-T boundary may not be restricted to the Bay of Biscay region only. We have examined several K-T boundary cores at DSDP core repositories to document biostratigraphic ranges of inoceramid shell fragments and prisms. As in our land based sections, prisms in the deep sea cores disappear well before the K-T boundary.

Ammonites show a very different extinction pattern than do the inoceramids. A minimum of seven ammonite species have been collected from the last meter of Cretaceous strata in the Bay of Biscay basin. In three of the sections there is no marked drop in either species numbers or abundance prior to the K-T boundary Cretaceous strata; at the Zumaya section, however, both species richness and abundance drop in the last 20 m of the Cretaceous, with only a single ammonite specimen recovered to date from the uppermost 12 m of Cretaceous strata in this section.

We conclude that inoceramid bivalves and ammonites showed two different times and patterns of extinction, at least in the Bay of Biscay region. The inoceramids disappeared gradually during the Early Maastrichtian, and survived only into the earliest Late Maastrichtian. Ammonites, on the other hand, maintained relatively high species richness throughout the Maastrichtian, and then disappeared suddenly, either coincident with, or immediately before the microfossil extinction event marking the very end of the Cretaceous.

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